FOODBORNE DISEASE OUTBREAKS IN CALIFORNIA, 1999-2000

Division of Communicable Disease Control
Infectious Diseases Branch
2151 Berkeley Way, Room 708
Berkeley, CA 94704
(510) 540-2566

September 2004

Arnold Schwarzenegger
Governor
STATE OF CALIFORNIA

Kimberly Belshé
Secretary
HEALTH AND HUMAN SERVICES AGENCY

Sandra Shewry
Director
DEPARTMENT OF HEALTH SERVICES

***** Contributors include: Janet Mohle-Boetani, MD, MPH; Ben Sun, DVM; Michelle Jay-Russell, DVM; Akiko Kimura, MD; Stan Bissell; Shu Sebesta; and S. Benson Werner, MD, MPH.

Foodborne Disease Outbreaks in California, 1999-2000

INTRODUCTION

Foodborne disease outbreaks (FBDOs) are reported to the California Department of Health Services (CDHS), Division of Communicable Disease Control (DCDC) by local health departments (LHDs). To prevent foodborne illness, data from foodborne outbreak investigations are used by public health practitioners to: (1) identify and remove contaminated products from sale, (2) identify and correct faulty food-handling and food-production practices, (3) better understand foodborne disease causation and propagation, (4) detect new foodborne pathogens, (5) detect new vehicles of foodborne pathogens, and (6) develop food safety programs and policies.

This report summarizes FBDOs reported in California that were reported in 1999 and 2000, comments on outbreaks due to norovirus infection, and summarizes food vehicles implicated in FBDOs from 1991 through 2000.

METHODS

Sources of Data

FBDOs are reported to CDHS on a standardized national reporting form (Centers for Disease Control and Prevention [CDC] Form #52.13, “Investigation of a Foodborne Outbreak”). These reports are prepared primarily by LHDs and sometimes by DCDC when the outbreak involves multiple counties. Data on these forms and any appended supplemental materials or reports are reviewed to determine: a) if etiologic agents are suspected or confirmed based on criteria developed by the CDC, b) if food vehicles are suspected or confirmed, and c) if an infected or symptomatic foodhandler was implicated in the investigation.

Definition of Terms

A FBDO is defined as the occurrence of two or more cases or suspected cases of a foodborne disease from separate households suspected to have the same source of illness. Outbreaks of confirmed etiology are those that meet the CDC definition of a confirmed etiology for a FBDO based, in general, on laboratory evidence of a specific agent in two or more cases. Outbreaks of suspected etiology are those for which the etiology is suspected (but not lab-confirmed), based on information such as symptoms, incubation period, and implicated food vehicle. For example, outbreaks with an incubation period of about 36 hours, with vomiting in more than 50 percent of patients, and with secondary cases are classified as “norovirus suspected.” Outbreaks of unknown etiology are those in which no single etiologic agent is confirmed or suspected.

For outbreaks with confirmed etiologies we also analyzed the food vehicles. A food vehicle was classified as confirmed if: 1) there was isolation of the etiologic agent from a food item (laboratory confirmation) or 2) an epidemiologic investigation found a statistically significant association (either a 95 percent confidence interval for the odds

ratio or relative risk that does not include one, or a p-value less than 0.05) between illness and a specific food item (epidemiologic confirmation).

If not confirmed, food vehicles can be suspected, based on the consumption of a food by a high proportion of cases or other data (such as consumption of only one food by cases).

Food vehicles were categorized into the following food groups: fresh produce (including fruit, juice, vegetables), meat and poultry, dairy, egg and egg dishes, and seafood. If the implicated food vehicle was made of ingredients from two or more of these groups (such as chicken salad or enchiladas), then the food vehicle was classified as "multiple." Food vehicles that were not in any of the aforementioned groups (such as beans or rice) were classified as "other."

Limitations of the Surveillance System

The limitations of the data presented in this report must be recognized to avoid misinterpretation. Reported FBDOs represent only a small fraction of outbreaks that actually occur. FBDOs can be reported by physicians, laboratorians, or citizens to LHDs after observing a cluster of illnesses or submission of specimens for analysis; clusters that are not investigated through laboratory testing can be detected only if medical personnel or citizens are sufficiently motivated to report the clusters to the LHD.

Outbreaks can also be detected by LHDs or by the state's laboratory through detection of a cluster of laboratory-confirmed cases. Detection of laboratory-confirmed cases requires several steps:

1) ill persons must seek medical attention,
2) appropriate specimens must be collected,
3) appropriate tests must be conducted, and
4) positive tests results must be reported to the LHD.

In California, by state regulation, all *Salmonella* isolates must be serotyped and reported. Cases of *Salmonella* infections that are serotyped are entered in a database and are regularly reviewed by the state's Microbial Diseases Laboratory (MDL). Most of the multicounty outbreaks detected in California are identified when clusters of infections from uncommon serotypes of *Salmonella* are detected. More recently, the use of pulsed-field gel electrophoresis (PFGE) has enabled the MDL to detect clusters of more common serotypes of *Salmonella* (e.g., *S*. Typhimurium) that have an uncommon DNA fingerprint.

Large outbreaks, multicounty or multistate outbreaks, restaurant-associated outbreaks, and outbreaks involving serious illness, hospitalizations, or deaths are more likely to come to the attention of health authorities than, for example, cases of mild illness after a family meal. Outbreaks with short latency periods (e.g., due to staphylococcal enterotoxin and chemical agents) are more likely to be recognized and reported than diseases with longer incubation periods (e.g., hepatitis A and cryptosporidiosis).

Interpretation of Data

A LHD's interest in foodborne disease and its resources for epidemiologic and laboratory investigation are important determinants of the extent to which foodborne diseases are investigated, the quality of those investigations, and the likelihood that foodborne outbreaks will be reported. Accordingly, local health jurisdictions with the highest foodborne outbreak rates should not be regarded as posing the greatest risk for foodborne infections or outbreaks. Rates can vary considerably between counties and from year to year because of the low numerator (the number of outbreaks) in the rate calculation for most local health jurisdictions.

RESULTS

Data from the CDHS surveillance system for reported FBDOs are presented as follows: outbreaks by year of onset and etiologic agent confirmation status (confirmed vs. suspected vs. unknown) 1993-2000 (Figure 1), 1999 and 2000 outbreaks by LHD (Table 1), 1999 and 2000 outbreaks by etiology, hospitalizations, and deaths (Table 2), food vehicles for confirmed outbreaks 1991-2000 by time period (Table 3), and selected 1999-2000 outbreak reports.

Reported Foodborne Disease Outbreaks
1999

In 1999, a total of 121 FBDOs, involving 3,325 cases, were reported to CDHS. This represents an increase of 20 percent in outbreaks reported compared with 1998. The etiologic agent was confirmed in 37 (31 percent) FBDOs, suspected in 55 (46 percent) FBDOs, and unknown in 29 (24 percent) FBDOs (Figure 1). Reports were received from 21 LHDs (Table 1). Los Angeles County reported the largest number of outbreaks (n=25), followed by San Diego County (n=21) and Orange County (n=17). Nine multicounty outbreaks were reported representing 451 cases. FBDOs ranged in size from 2 cases in each of 6 outbreaks to 460 cases of suspected *C. perfringens* or *B. cereus* associated with chili beans with sirloin steak (epidemiologically confirmed).

2000

In 2000, a total of 141 FBDOs, involving 3,716 cases were reported to CDHS. This represents an increase of 17 percent in outbreaks compared with 1999. The etiologic agent was confirmed in 45 (32 percent) FBDOs, suspected in 71 (50 percent) FBDOs, and unknown in 25 (18 percent) FBDOs (Figure 1). Reports were received from 27 LHDs (Table 1). Los Angeles County reported the largest number of outbreaks (33 outbreaks, 1,177 cases), followed by San Diego County (18 outbreaks, 317 cases), and Orange County (17 outbreaks, 298 cases). Eight multicounty outbreaks were reported representing 422 cases. FBDOs ranged in size from 2 cases in each of 8 outbreaks to 270 cases of suspected *C. perfringens* associated with turkey (epidemiologically confirmed).

Outbreaks by Etiology
1999

Bacterial pathogens were confirmed in 35 outbreaks (95 percent of confirmed outbreaks) and accounted for 1,201 cases (Table 2). *Salmonella* was isolated in 23 outbreaks with a total of 756 cases (66 percent of bacterial outbreaks). *Salmonella* serotype Enteritidis caused 14 outbreaks (61 percent of *Salmonella* outbreaks), accounting for 373 cases.

One confirmed outbreak was due to a **parasite** (*Anisakis*, 14 cases). The one confirmed **viral** outbreak was caused by norovirus (13 cases). No confirmed outbreaks due to **chemical** agents were reported.

Salmonella serotype Enteritidis was the single agent that caused the greatest number of outbreaks, accounting for 38 percent of the confirmed outbreaks and 12 percent of all outbreaks.

2000

Bacterial pathogens were confirmed in 27 outbreaks (60 percent of confirmed outbreaks) and accounted for 1,043 cases (Table 2). *Salmonella* was isolated in 19 outbreaks with a total of 346 cases (70 percent of bacterial outbreaks). *Salmonella* serotype Enteritidis caused 6 outbreaks and accounted for 155 cases (32 percent of Salmonella outbreaks).

One confirmed outbreak was due to a **parasite** (*Trichinella*, 2 cases). **Viral** pathogens were confirmed in 15 outbreaks and accounted for 435 cases (33 percent of confirmed outbreaks). Norovirus was confirmed in 14 outbreaks (425 cases) and hepatitis A in 1 outbreak (10 cases). Two confirmed outbreaks due to **chemical** agents were reported; both were due to *Scombroid* toxin (histamine).

Norovirus was the single agent that caused the greatest number of outbreaks, accounting for 31 percent of the confirmed outbreaks and 10 percent of all outbreaks.

Norovirus

In 1999, there were 1 confirmed and 39 suspected FBDOs due to norovirus infections. In 2000, there were 14 confirmed and 29 suspected FBDOs due to norovirus infections. Although the proportion of all FBDOs due to suspected or confirmed norovirus infections remained stable (33 percent in 1999 and 29 percent in 2000), the proportion of confirmed outbreaks, among those suspected or confirmed as norovirus, increased from 2.5 percent in 1999 to 33 percent in 2000.

Among the 15 confirmed outbreaks due to norovirus infection, 7 (47 percent) were reported to be due to an infected or ill foodhandler. Among the 15 confirmed outbreaks due to norovirus infection, 5 (33 percent) had a vehicle confirmed through epidemiologic

evidence. The confirmed vehicles were: iced tea, taco bar items, fresh fruit, chicken sandwiches, and tuna sandwiches. In one outbreak, raw tuna fish was the suspected food vehicle; nine outbreaks had unknown food vehicles.

Outbreaks by Food Vehicle

In 1999-2000, there were 82 outbreaks with confirmed etiologies, of which 43 (52 percent) had a confirmed food vehicle: 27 (63 percent) were confirmed by epidemiologic data alone, 11 (26 percent) by laboratory data alone, and 5 (12 percent) by both epidemiologic and laboratory data. A confirmed food vehicle was found for all or almost all outbreaks of *C. botulinum* (1 of 1 outbreak), *E. coli* O157 (2 of 3 outbreaks), *C. perfringens* (5 of 5 outbreaks), shigellosis (6 of 8 outbreaks), parasites (2 of 2 outbreaks), and scombroid (2 of 2 outbreaks). For *C. perfringens* and scombroid the etiology of the outbreak itself was confirmed through identification of the pathogen in a food. A confirmed food vehicle was found in 48 percent of outbreaks due to *Salmonella* (20 of 42 outbreaks) and in 31 percent of outbreaks due to viral pathogens (5 of 16 outbreaks).

Of outbreaks with confirmed food vehicles, laboratory confirmation of food vehicles predominated for outbreaks due to *Clostridium perfringens* (4 of 5 outbreaks), scombroid (2 of 2 outbreaks), *Clostridium botulinum* (1 of 1 outbreak), and parasites (2 of 2 outbreaks). In contrast, epidemiologic but not laboratory confirmation predominated for viral outbreaks (5 of 5 outbreaks) and outbreaks of infections with *Salmonella* (15 of 20 outbreaks), *Shigella* (5 of 6 outbreaks), and *E. coli* O157 (2 of 2 outbreaks).

Of the 43 outbreaks with confirmed food vehicles in 1999-2000, one-third (14 of 43 outbreaks) were associated with fresh produce products: 7 (16 percent) with vegetables (e.g., sprouts and cilantro), 5 (12 percent) with fruits (e.g., cantaloupe, mango, and red grapes), and 2 (5 percent) with unpasteurized orange juice. Sixteen (37 percent) outbreaks were associated with animal related vehicles which included 11 (26 percent) outbreaks associated with meat (3 beef, 3 chicken, 3 fish, 1 goat meat, 1 bear meat) and 5 (12 percent) with eggs or egg-containing dishes. Additionally, 9 (21 percent) outbreaks were associated with vehicles other than meat, dairy, or produce (e.g., iced tea or beans) and 4 (9 percent) with items from multiple categories (e.g., salads or sandwiches).

The proportion of FBDOs with confirmed vehicles of fresh produce increased dramatically since the early 1990s. In 1991-95, only one (2 percent) of 56 outbreaks with confirmed food vehicles was due to fresh produce. In 1996-2000, 30 percent (29 of 96 outbreaks) were due to fresh produce. Compared with 1991-98, the years of 1999-2000 showed a dramatic decrease in the proportion of egg-related FBDOs.

Selected Reports of the Most Notable FBDOs in 1999-2000

1999

Investigation of a MultiState Outbreak Linked to Ground Beef Tacos at a Fast-Food Restaurant Chain

In November 1999, systematic screening of stools for *E. coli* O157 by Children's Hospital in Fresno revealed a cluster of children with *E. coli* O157 infections. Case-finding was conducted by posting the PFGE pattern of the isolates from this cluster on PulseNet. A total of 14 cases of *Escherichia coli* O157:H7 infections with matching PFGE patterns were identified. The patients resided in California, Arizona, and Nevada. Five (36 percent) were hospitalized and three (21 percent) had the hemolytic uremic syndrome; there were no deaths. The median age was 12 years (range 2-75 years) and ten (71 percent) were female. Case-control studies found an association between illness and eating a beef taco (88 percent of case-patients versus 38 percent of controls; MOR = infinity, 95 percent C.I. = 1.49-infinity, p value = 0.009) at a fast-food restaurant chain. A traceback investigation implicated an upstream supplier of beef, but a farm investigation was not possible because of inadequate recordkeeping by the supplier. This outbreak illustrates the success of hospital surveillance to identify clusters, combined with molecular surveillance to link related cases that are geographically widespread. The investigation revealed the need to create an efficient tracking system for beef products.

An Outbreak of *Salmonella* Newport Associated with Mangos from Brazil

In December 1999, both the Los Angeles Department of Health Services and CDHS noted an increase in *Salmonella* serotype Newport infections. Concurrently, CDC detected a nationwide increase in *Salmonella* serotype Newport infections. *S*. Newport isolates from patients in this cluster had an indistinguishable PFGE pattern, suggesting a common source. The magnitude and cause of the outbreak were determined by national case-finding and a case-control study. A case was defined as infection with the outbreak strain during November or December 1999. A total of 79 patients from 13 states were infected with the outbreak strain; 29 were from California. 40 percent of patients were either self-identified as Hispanic or Asian or had compatible surnames. The median age for case patients was 38 years (range: 7 weeks-91 years). Fifteen patients were hospitalized; two patients died. Among 28 patients enrolled in the matched case-control study, 14 (50 percent) ate mangoes in the five days before illness onset compared with 4 (10 percent) age and ethnicity matched controls during the same time period (matched odds ratio = 21.6; 95 percent confidence interval = 3.53 to infinity, p=0.0001). A traceback investigation of the implicated mangoes led to one farm in Brazil.

Salmonella Thompson Outbreak Associated with Cilantro

In April 1999, an increase in *Salmonella* Thompson was identified in several counties in California. To determine a common source, a case-control study was conducted. Case-patients and their matched controls were asked about foods eaten in the week

before the case-patient's illness onset. An association with eating fresh cilantro was identified and it represented the first time that a salmonellosis outbreak in California was found to be associated with cilantro. A traceback investigation was conducted that was limited to restaurants where more than one case-patient ate or where the restaurant represented the only source of cilantro exposure for case-patients. Although there was some overlap in cilantro suppliers for these restaurants, no single supplier in common could be identified. The traceback investigation was hampered by incomplete recordkeeping among distributors of cilantro. One recommendation from this investigation was to improve recordkeeping for cilantro (and other produce) so that efficient and accurate traceback investigations can be conducted. Follow-up studies were done on cut and uncut cilantro and showed growth of *Salmonellae* on cut cilantro. These studies led to recommendations for improving the handling of cilantro at the retail and restaurant level.

Shigella Outbreak Due to a Bean Dip 2000

In January 2000, a multi-state outbreak due to *Shigella sonnei* occurred. Illness was associated with eating a commercially prepared five-layered bean dip. Overall, 406 persons with *S. sonnei* infection who had eaten the dip in the week prior to illness were identified in ten states; 217 (53 percent) were from California. *S. sonnei* with a PFGE pattern indistinguishable from the outbreak strain was isolated from an unopened package of dip. Numerous problems in manufacturing practices and quality control were noted at the dip manufacturing facility. Environmental and employee stool samples did not yield *S. sonnei*; however, one employee reported working while ill with diarrhea during the week before the outbreak. This was the largest recognized U.S. shigellosis outbreak due to a widely distributed ready-to-eat food item. The outbreak ended after the contaminated dip was recalled.

An Outbreak of Salmonellosis Traced to a Foodhandler

In the summer of 2000, an increase in *Salmonella* serotype Thompson (ST) was noted in Southern California. Most of the case-patients reported eating at the same restaurant chain (Chain A) before illness onset. Potential cases were identified through laboratory-based surveillance in California, and other states with Chain A franchises were contacted. During the investigation, 62 ST cases were identified in California and Arizona; 40 were interviewed. Seventeen cases in Southern California and six cases in Arizona reported eating at a Chain A restaurant prior to onset. To identify food risk factors for illness at Chain A these 23 cases and their 30 well meal companions were included in a case-control study. Eating hamburgers was the only risk factor for illness. Hamburgers were consumed by 23 (100 percent) cases and 4 (13 percent) controls (odds ratio undefined, $p<0.001$). The ST case with the earliest onset did not eat at Chain A, but was employed at Bakery B where she had packed hamburger buns while ill with diarrhea. Bakery B was the sole supplier of hamburger buns to Chain A restaurants in Southern California and Arizona. An additional 12 ST cases were part of an outbreak in Southern California where the cases had not eaten at Chain A but had

eaten Bakery B buns served at a barbecue luncheon. This outbreak is notable for implicating a foodhandler as the source of food contamination and for involving a bread product (hamburger buns), an unusual vehicle for *Salmonella* transmission.

Salmonella Enteritidis Outbreak Associated with Mung Bean Sprouts

In April 2000, an increase in *S*. Enteritidis infections was identified in Northern California. Many patients had eaten at a Vietnamese restaurant chain so a cohort study was conducted among patrons of this restaurant chain to identify a specific food associated with illness. This study revealed an association with eating a cold crepe appetizer from the Vietnamese restaurant chain. A case-control study, focused on the ingredients in the appetizer, was then conducted among patients who had not eaten at the Vietnamese restaurant chain and community matched controls. This study revealed an association with eating raw mung bean sprouts. A traceback investigation revealed a common sprouter. Investigation of that sprouter identified the same rare phage type of *S*. Enteritidis in a drain in the sprouting facility. Cases were also identified in Nevada and Oregon; all of these out-of-state patients had eaten raw mung bean sprouts from the implicated sprouter who shipped sprouts to Oregon and Nevada. This investigation revealed a new vehicle for *S.* Enteritidis and demonstrated that mung bean sprouts, in addition to alfalfa sprouts, can cause foodborne illness outbreaks.

A Multi-State Outbreak of *Salmonella* Poona Associated with Cantaloupes

A multi-state outbreak investigation of *Salmonella* serotype Poona (SP) infections with indistinguishable PFGE patterns was identified and involved 46 case-patients residing in California (26 cases), Colorado (1), New Mexico (3), Nevada (4), Oregon (2), and Washington (10) during April through June 2000. Nine (35 percent) California case-patients were hospitalized and no deaths were reported. California case-patients were residents of 16 counties. The median age of California case-patients was seven years old (range 1-95 years) and 14 (54 percent) were female. A matched case-control study of cases in California, Oregon, and Washington using a telephone-administered standard questionnaire found an association between illness and cantaloupe consumption (90 percent of case-patients ate cantaloupe versus 26 percent of controls; matched odds ratio (MOR)= 9.0, 95 percent confidence interval (CI)=2.6-75.0, p= 0.0007). A traceback investigation was conducted by the Food and Drug Administration (FDA) and traced the origin of the implicated cantaloupes to a farm in Mexico. The mechanism of contamination was not determined; however, a contaminated water supply was suspected. Recommendations were made to the general public to wash cantaloupes prior to preparation, observe good food handling practices, and to properly refrigerate and store cut melons.

DISCUSSION

<u>Increase in Detection of Norovirus Infections Outbreaks</u>

While bacterial pathogens were responsible for most of the FBDOs and cases with a confirmed etiology, in 2000 there was a notable increase in the number of confirmed outbreaks due to norovirus infection. Although a majority of suspected viral outbreaks

are unconfirmed, the large increase in the proportion confirmed in 2000 compared with prior years is due primarily to the use of new laboratory methods with increased sensitivity in detecting norovirus.

Noroviruses are a group of genetically and antigenically diverse single-stranded RNA viruses that are classified in the genus *Norovirus* in the family *Caliciviridae* and were previously known as Norwalk-like viruses (NLV) or small, round-structured viruses (SRSVs). Primary cases in a foodborne outbreak result from a vehicle contaminated by feces or vomitus and secondary cases result from person-to-person spread. Recent studies suggest that persons may remain contagious for longer than 72 hours after recovery. The low infectious dose allows spread by droplets, person-to-person, and fomites in the environment. Repeated infections can occur throughout life though there is a refractory or "short-lived immunity" period of about six months before there can be re-infection by the same strain.

Because noroviruses are human and not zoonotic pathogens, food vehicles that transmit norovirus tend to be contaminated by human feces (or vomitus) from an ill foodhandler. In California, only 47 percent of norovirus infection outbreaks documented an ill foodhandler but, in some outbreaks, illness among foodhandlers may not have been sought. The confirmed vehicles in the norovirus outbreaks in California are consistent with contamination by a foodhandler: they were foods that required handling but no subsequent cooking (e.g., salads, deli sandwiches, and taco bar items). Noroviruses can also be waterborne; in one outbreak in California iced tea was implicated, and it could have been the ice that was contaminated. It is important to document the existence of illness (or not) in foodhandlers in every outbreak of norovirus infection.

Noroviruses cause a high proportion of foodborne outbreaks. Norovirus outbreaks are suspected if the following criteria are met:

1) stool specimens are negative for bacterial and parasitic pathogens;
2) the percentage of cases with vomiting is greater than or equal to 50 percent;
3) the mean (or median) duration of illness is 12-60 hours; and
4) if available, the mean (or median) incubation period is 24-48 hours.

Until recently, most outbreaks due to norovirus were suspected rather than confirmed. New laboratory techniques have improved the ability to detect norovirus and have contributed to the increase in confirmed outbreaks (33 percent of confirmed outbreaks in 2000 compared with less than 2 percent in prior years). In California, reverse transcription-polymerase chain reaction (RT-PCR) has been used recently to detect noroviruses; the use of this test directly resulted in the greater extent of confirmation of norovirus infections among FBDOs in 2000.

Even with sensitive laboratory techniques, the detection of noroviruses can occur only if investigators collect clinical and environmental specimens in an appropriate and timely manner. Whenever a case of viral or chemical etiology is suspected, proper specimens should be requested in consultation with the laboratory. Specimen collection for viral testing should begin on day one of the epidemiologic investigation and should be

obtained as soon as possible after onset, especially while the stools are still liquid or semisolid to increase sensitivity of the testing. Ideally, specimens from five to six persons should be obtained. Bulk samples (10-50 ml of feces) should be collected in a clean, but not necessarily sterile, stool cup, or urine container. The smaller the specimen and the more formed the stool, the lower the diagnostic yield. However, with PCR, noroviruses can be detected from formed stools collected several days after illness onset. Rectal swabs are of limited or no value. Specimens should be stored at 4° C and should not be frozen. Specimens can be stored for two to three weeks while awaiting the results of tests for other pathogens. Vomitus specimens can also be submitted following the same guidelines as for stool specimens.

Food Vehicles 1991-2000

A larger proportion of confirmed outbreaks were associated with fresh produce in 1996-2000 compared to 1991-95. The increased detection of produce-related outbreaks could be explained, in part, by the increased use of laboratory molecular subtyping techniques (such as PFGE) to detect widespread FBDOs. In many produce-associated outbreaks, the case-patients resided in several counties and there were only one to two patients in any one county. The paucity of case-patients in any one local health jurisdiction is likely due to low level contamination of the produce. Most of these outbreaks could not be detected at the local level and were detected only because of subtyping conducted at the state's MDL.

Salmonella was the most frequently reported agent in confirmed outbreaks in both the 1991-98 and 1999-2000 time periods and was reported in virtually every food category. Conversely, for the same time frame, scombroid and ciguatera fish poisoning, parasitic agents, and foodborne botulism were reported only in the classical food categories: seafood, meat products, home-canned produce, and fish, respectively. *Shigella* and norovirus infection outbreaks tended to be associated with the "multiple food" items or "other" food categories. The multiple food item category is consistent with a foodhandler associated outbreak and both of these pathogens are solely human pathogens, easily spread by infected foodhandlers.

The epidemiology of foodborne disease has changed in recent years. New pathogens, new vehicles such as raw produce, changes in consumer behavior such as eating more meals away from home, globalization of the food supply, and changes in the way food is produced and distributed are factors that influence the type and occurrence of FBDOs today. Through enhanced epidemiologic and laboratory surveillance, more outbreaks are also being detected and investigated.

DCDC has been increasing efforts to recognize, investigate, test, and report FBDOs.

1) The Infectious Diseases Branch (IDB) has enhanced surveillance for foodborne outbreaks by reminding LHDs to report FBDOs using the standard foodborne disease reporting form.
2) IDB has increased the investigation and reporting of outbreaks involving multiple counties.

3) California has three counties (Alameda, Contra Costa, and San Francisco) that are part of the California FoodNet site, with enhanced surveillance, investigation, and understanding of foodborne illnesses in those three jurisdictions.
4) CDHS MDL has recently linked cases by using PFGE to facilitate the identification of outbreaks over broad geographic areas in multiple counties.
5) CDHS Viral and Rickettsial Disease Laboratory began using RT-PCR to detect noroviruses.

These efforts could account for the large increase in the number of FBDOs in 1999-2000. Other factors that could have contributed to the increase in FBDOs include: consumer behavior; production and distribution of the food supply; increased surveillance, recognition, investigation, and reporting of FBDOs by LHDs; and increased awareness among the public and medical communities of the foodborne disease and the need to report them.

Despite the increased detection of outbreaks, the high proportion of FBDOs that do not have a confirmed etiology (69 percent in 1999 and 68 percent in 2000) highlights the need for improved epidemiologic and laboratory investigations of outbreaks that are detected. Prompt investigation and sample collection are essential to:

1) control a FBDO,
2) understand the factors that contributed to the outbreak, and
3) prevent future outbreaks.

LHDs should be aware of the following resources:

- "Procedures to Investigate Foodborne Illness, 5th edition." Des Moines, Iowa, 1999. To obtain a copy, contact the International Association for Food Protection (formerly IAMFES) at 1-800-369-6337 or visit www.foodprotection.org for more information.

- A document entitled "Multistate Foodborne Outbreak Investigations: Guidelines for Improving Coordination and Communication" can be downloaded from the FDA website at: http://www.fda.gov/ora/fed_state/NFSS/Outbreak_Coordination.pdf

- The FDA's three-part video course on:

  1) Food Microbiological Control,
  2) Foodborne Epidemiological Investigations, and
  3) Traceback Investigations. These video courses and manuals are available for loan, at no charge, through the FDA by calling (301) 594-3682 or visiting the website at: http://www.fda.gov/ora/training/course_ora.html

- A joint report by the American Medical Association, Centers for Disease Control and Prevention (CDC), Food and Drug Administration, and U.S. Department of Agriculture entitled "Diagnosis and Management of Foodborne Illnesses: a Primer for Physicians." The reference is: MMWR 2001; 50 (No. RR-2). The report is also available on the CDC website at: http://www.cdc.gov/mmwr/PDF/RR/RR5002.pdf

- CDC. Norwalk-like viruses, public health consequences and outbreak management. MMWR 2001;50 (No. RR-9). This report is available on the CDC website at: http://www.cdc.gov/mmwr/PDF/RR/RR5009.pdf

- CDC Norovirus Technical Fact Sheet at: http://www.cdc.gov/ncidod/dvrd/revb/gastro/norovirus.htm

- DCDC staff are available for consultation and assistance with epidemiologic and laboratory aspects of FBDO investigations. Please call the Infectious Diseases Branch at (510) 540-2566 during normal business hours, or the duty officer at (510) 540-2308 after hours or on weekends. For laboratory questions or assistance, please contact the MDL at (510) 540-2242 or the VRDL at (510) 307-8585.

REFERENCES

California Department of Health Services, Communicable Diseases in California, 1994-1998. July 2001.

California Department of Health Services, Foodborne Outbreaks Reported in California, 1998. December 2000. http://www.dhs.ca.gov/ps/dcdc/disb/disbindex.htm

California Department of Health Services, Foodborne Outbreaks in California 1993-94. California Morbidity, May 1995. http://www.dhs.ca.gov/ps/dcdc/cm/950519CM.htm

California Department of Health Services, *Salmonella* serotype Enteritidis in California: Current status and containment efforts. California Morbidity, Jan 1999. http://www.dhs.ca.gov/ps/dcdc/cm/pdf/cm9901pp.pdf

California Department of Health Services, Gastroenteritis associated with Tomales Bay oysters - Investigation, prevention, and control. California Morbidity, Dec 1998. http://www.dhs.ca.gov/ps/dcdc/cm/pdf/cm9812pp.pdf

CDC. Surveillance for foodborne disease outbreaks – United States, 1993-1997. MMWR 2000;49 (No. SS-1):1-64. This document contains the criteria to confirm etiologies for foodborne disease outbreaks. http://www.cdc.gov/mmwr/preview/mmwrhtml/ss4901a1.htm

Mead PS, Slutsker L, Dietz V, et al. Food-related illness and death in the United States. Emerg Infect Dis 1999;5:607-625. http://www.cdc.gov/ncidod/eid/vol5no5/mead.htm

Tauxe R. Emerging foodborne diseases: An evolving public health challenge, Emerg Infect Dis 1997;4:425-434. http://www.cdc.gov/ncidod/eid/vol3no4/tauxe.htm

ADDITIONAL REFERENCES

CDC. Recommendations for Collection of Laboratory Specimens Associated with Outbreaks of Gastroenteritis. MMWR 1990;39 (No. RR-14):1-13. http://www.cdc.gov/mmwr/preview/mmwrhtml/00001829.htm

Chin J. Control of Communicable Disease Manual, 17th edition. American Public Health Association, 2000. http://www.apha.org/media/science.htm

Massachusetts Foodborne Illness Investigations and Control Manual http://www.state.ma.us/dph/fpp/refman.htm

FDA Bad Bug Book http://vm.cfsan.fda.gov

Table 1. Foodborne disease outbreaks by local public health jurisdiction by local jurisdiction, California, 1999 and 2000 [1]

Jurisdiction	Population 1999	Foodborne Outbreaks 1999	Rate of Outbreaks 1999	Population 2000	Foodborne Outbreaks 2000	Rate of Outbreaks 2000
MULTIPLE		9			8	
ALAMEDA [2]	1,311,900		0.00	1,335,800	4	0.30
Berkeley	102,200	1	0.98	102,500	1	0.98
ALPINE	1,180		0.00	1,190		0.00
AMADOR	34,450		0.00	35,050	1	2.85
BUTTE	201,000		0.00	203,100		0.00
CALAVERAS	40,000		0.00	40,500		0.00
COLUSA	18,550		0.00	18,800		0.00
CONTRA COSTA	928,500		0.00	946,300		0.00
DEL NORTE	27,750		0.00	27,600	4	14.49
EL DORADO	153,200		0.00	157,100	1	0.64
FRESNO	785,000		0.00	797,900		0.00
GLENN	26,300		0.00	26,550		0.00
HUMBOLDT	125,900		0.00	126,700		0.00
IMPERIAL	140,000		0.00	143,900		0.00
INYO	18,200		0.00	18,150		0.00
KERN	647,000	2	0.31	660,200		0.00
KINGS	125,400	1	0.80	128,800		0.00
LAKE	57,300		0.00	58,200	1	1.72
LASSEN	33,600		0.00	34,000		0.00
LOS ANGELES [2]	8,746,400	25	0.29	8,893,900	33	0.37
Long Beach	451,500	3	0.66	459,900		0.00
Pasadena	132,200		0.00	133,600	1	0.75
MADERA	120,300		0.00	124,500	1	0.80
MARIN	243,800	1	0.41	246,300		0.00
MARIPOSA	16,900		0.00	17,000		0.00
MENDOCINO	85,500		0.00	86,400	1	1.16
MERCED	205,900	1	0.49	208,800		0.00
MODOC	9,550		0.00	9,400		0.00
MONO	12,350		0.00	12,700		0.00
MONTEREY	390,500	2	0.51	398,900	4	1.00
NAPA	121,900		0.00	124,100		0.00
NEVADA	90,600		0.00	91,500		0.00
ORANGE	2,776,100	17	0.61	2,829,800	17	0.60
PLACER	238,300	2	0.84	246,100		0.00
PLUMAS	20,800	1	4.81	20,750	1	4.82
RIVERSIDE	1,490,500	1	0.07	1,533,800	4	0.26
SACRAMENTO	1,185,100	8	0.68	1,217,600	1	0.08
SAN BENITO	51,200		0.00	53,000		0.00
SAN BERNARDINO	1,666,600	6	0.36	1,701,700	10	0.59
SAN DIEGO	2,751,000	21	0.76	2,805,900	18	0.64
SAN FRANCISCO	762,400	10	1.31	775,000	7	0.90
SAN JOAQUIN	549,200		0.00	561,200		0.00
SAN LUIS OBISPO	242,100		0.00	245,800	2	0.81
SAN MATEO	698,300	4	0.57	706,300	6	0.85
SANTA BARBARA	393,500	4	1.02	398,200		0.00
SANTA CLARA	1,658,000	1	0.06	1,679,200	4	0.24
SANTA CRUZ	251,600		0.00	255,100		0.00

Table 1. Foodborne disease outbreaks (continued)

Jurisdiction	Population 1999	Foodborne Outbreaks 1999	Rate of Outbreaks 1999	Population 2000	Foodborne Outbreaks 2000	Rate of Outbreaks 2000
SHASTA	162,000		0.00	163,700	1	0.61
SIERRA	3,810		0.00	3,700		0.00
SISKIYOU	44,350		0.00	44,500		0.00
SOLANO	384,000		0.00	391,700	1	0.26
SONOMA	449,500		0.00	457,300	4	0.87
STANISLAUS	436,100		0.00	445,900	3	0.67
SUTTER	77,500		0.00	78,700	1	1.27
TEHAMA	55,500		0.00	55,700		0.00
TRINITY	13,150		0.00	13,050		0.00
TULARE	362,200	1	0.28	367,000		0.00
TUOLUMNE	54,000		0.00	54,500		0.00
VENTURA	736,000		0.00	750,500	1	0.13
YOLO	163,500		0.00	167,400		0.00
YUBA	60,500		0.00	60,400		0.00
STATE	33,140,000	121	0.37	33,753,000	141	0.42

(1) A local health jurisdiction's interest in foodborne disease and its resources for epidemiologic and laboratory investigation are important determinants of the extent to which foodborne disease outbreaks are investigated, the quality of those investigations, and the likelihood such outbreaks will be reported. Accordingly, local health jurisdictions with the highest foodborne outbreak rates should not be regarded as posing the greatest risk for foodborne infections or outbreaks. Rates can vary considerably between counties and from year to year because of the low numerator (the number of outbreaks) in the rate calculation for most local health jurisdictions.

(2) The population for Alameda County excludes the population of Berkeley; the population for Los Angeles County excludes the populations for Long Beach and Pasadena.

Rates are per 100,000 population.

Source: State of California, Department of Finance, Revised Historical City, County and State Population Estimates, 1991-2000, with 1990 and 2000 Census Counts. Sacramento, California, March 2002.

Table 2. Foodborne-disease outbreaks, cases, hospitalizations, and deaths by confirmed etiology, California, 1999-2000

Etiology	1999 Outbreaks No. (percent)	Cases	Hospitalizations	Deaths	2000 Outbreaks No. (percent)	Cases	Hospitalizations	Deaths
Total Bacterial	**35 (95)**	**1,201**	**79**	**0**	**27 (60)**	**1,043**	**76**	**1**
Campylobacter	1 (3)	13	1	0	1 (2)	2	0	0
Clostridium botulinum	0 (0)	0			1 (2)	2	2	0
Clostridium perfringens	3 (8)	288	0	0	2 (4)	233	1	0
Escherichia coli O157	2 (5)	18	8	0	1 (2)	14	8	0
Salmonella non- Enteritidis	9 (24)	383	37	0	13 (29)	191	50	0
Salmonella Enteritidis	14 (38)	373	27	0	6 (13)	155	7	0
Shigella	5 (14)	122	6	0	3 (7)	446	8	1
Vibrio parahaemolyticus	1 (3)	4	0	0	0 (0)	0	0	0
Total Parasitic	**1 (3)**	**14**	**0**	**0**	**1 (2)**	**2**	**2**	**0**
Total Chemical	**0 (0)**	**0**	**0**	**0**	**2 (4)**	**13**	**0**	**0**
Scombroid	0 (0)	0	0	0	2 (4)	13	0	0
Total Viral	**1 (3)**	**13**	**0**	**0**	**15 (33)**	**435**	**2**	**1**
Hepatitis A	0 (0)	0	0	0	1 (2)	10	1	1
Norovirus	1 (3)	13	0	0	14 (31)	425	1	0
TOTAL (all confirmed etiologies)	**37 (100)**	**1,228**	**79**	**0**	**45 (100)**	**1,493**	**80**	**2**

Table 3. Confirmed FBDOs [1] by confirmed food vehicle category [2] and time period, California, 1991-2000 (N=152) [3]

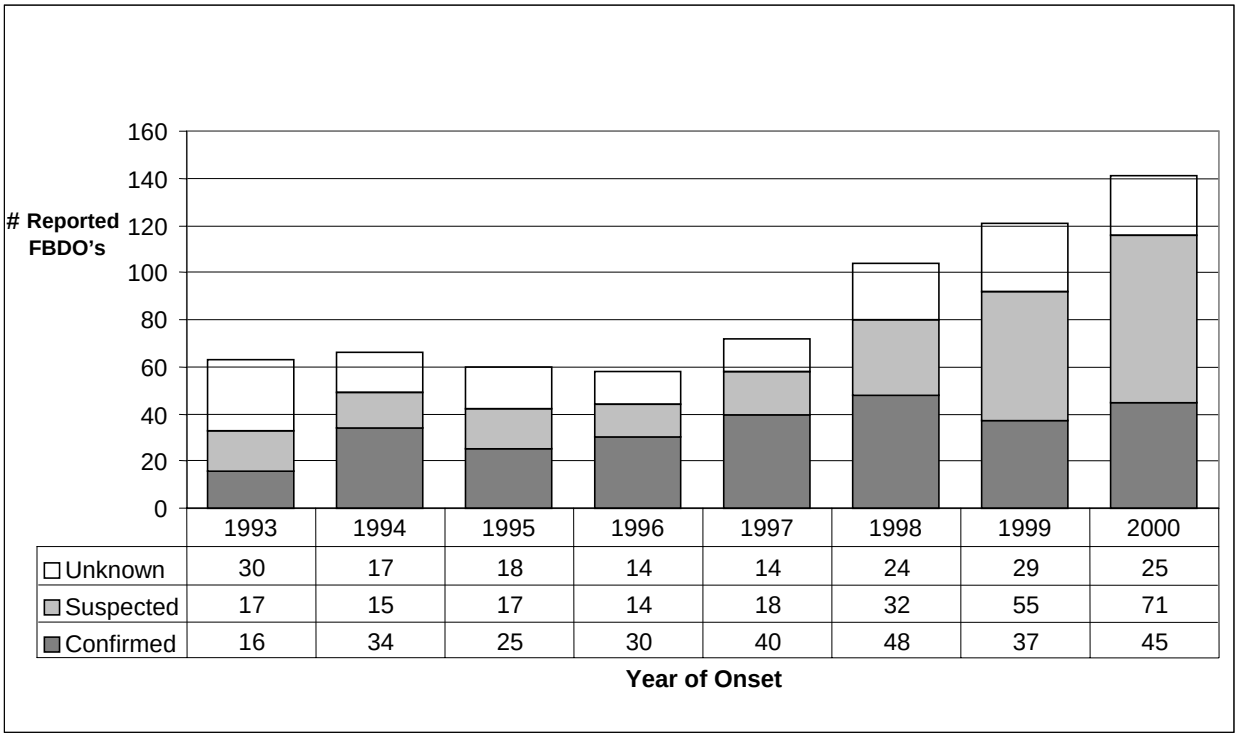
Confirmed Vehicle	1991-1998 Outbreaks # (percent)	1999-2000 Outbreaks # (percent)
Fresh Produce (Fruit, Juice, or Vegetables)	17 (16)	14 (33)
Meat and Poultry	23 (21)	8 (19)
Dairy	5 (5)	0 (0)
Egg and Egg Dishes	24 (22)	5 (12)
Seafood	8 (7)	3 (7)
Multiple	15 (14)	4 (9)
Other	17 (16)	9 (21)
Total	109 (100)	43 (100)

(1) Confirmed FBDOs = Foodborne disease outbreaks that meet the CDC definition of a confirmed etiology based, in general, on laboratory evidence of a specific agent in two or more cases.

(2) Food vehicles were confirmed by laboratory detection of the etiologic agent in the food or by a statistically significant association in an epidemiologic investigation.

(3) This table excludes outbreaks with a confirmed etiology that did not have a confirmed food vehicle. For example, in 1999-2000 there were 82 outbreaks with confirmed etiologies but only 43 had confirmed food vehicles; only these 43 outbreaks were included in the table.

Figure 1. Foodborne disease outbreaks (FBDOs) by year of onset and etiologic agent confirmation status, California, 1993-2000 (N=685).



	1993	1994	1995	1996	1997	1998	1999	2000
Unknown	30	17	18	14	14	24	29	25
Suspected	17	15	17	14	18	32	55	71
Confirmed	16	34	25	30	40	48	37	45